fully automated segmentation has the potential for widespread use since it offers a high throughput and is available for use now. We anticipate further development to include more automated features, which will additionally reduce the reader time.
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MODELLING OF SHAPE CHANGES IN THE FEMUR IN OSTEOARTHRITIS USING ACTIVE SHAPE MODELLING. QUANTIFICATION, EARLY IDENTIFICATION AND IDENTIFICATION OF FAST PROGRESSORS

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Introduction: As osteoarthritis (OA) progresses, changes occur in the shape of the femoral head, it becomes flattened and deformed. This study used the active shape modelling (ASM) technique to model and quantify these changes over a six-year period and between OA and control subjects. We found that the ASM was not only able to model and quantify the changes occurring over the course of OA, but also found significant differences in the same variables between individuals who did and did not require surgical intervention over the study, indicating a marker for a poor prognosis.
Methods: 110 age and sex matched subjects were selected from the Rotterdam study. Standard pelvic radiographs were taken at baseline and 6 years later. Each radiograph was assessed by 2 trained rheumatologists using the Kellgren-Lawrence (KL) scale. The control group comprised 55 subjects who had a KL score of 0 for both hips at both baseline and follow-up. The OA group included 55 subjects whose KL score was 0 or 1 at baseline examination and increased by at least 3 points by follow-up. Total hip replacements were performed between baseline and follow-up in 12 of the OA subjects, making it impossible to measure the shape of the operated proximal femur at follow-up. This split the OA group into 2 subgroups, the THR group and the No-THR group.
An ASM measures variation within a set of shape by statistical modelling of the position of a set of points that describe the outline of a shape. A 16-point ASM was used in this study, outlining the femoral head and the upper femoral neck. The shape was described by a series of independent 'modes of variation', each of which is expressed as a score representing how many standard deviations it lies from the mean value of that mode.
Results: The ASM identified significant shape changes in the femoral head of the OA group. Mode 1 modelled the flattening and deformation of the femoral head as OA progresses and this score changed significantly during the study in the OA group ($P < 0.0001$). The mode 6 score also changed significantly in this group ($P = 0.002$). Correspondingly, a significant difference was found in mode 6 between the OA and control groups at follow-up ($P = 0.021$). Of particular note, mode 6 was also significantly lower in the OA than the control group at baseline, before OA was detected using the KL score ($P = 0.03$). The same mode also appeared to be related to the severity of OA, with the THR group having a lower score at baseline than the No-THR group ($P = 0.018$).
Conclusions: This pilot study has shown that active shape modelling can quantify the changes that occur in the femoral head during the course of OA. This was identified in the mode 1 and mode 6 scores. In addition to this, the mode 6 score not only appears to identify OA patients before standard clinical assessment, but also may be an indicator which subjects have rapid progression and require surgical intervention. Lower mode 6 scores appear to be associated with more severe OA and a poorer prognosis.

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DETAILED MAPPING OF OA LESIONS AFTER COMPLETE MEDIAL MENISCECTOMY

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Aim: Detailed mapping and characterization of macroscopical and histological OA lesions after complete medial meniscectomy using the International Cartilage Repair Society (ICRS) scheme
Methods: 2 groups of NZW rabbits were studied: complete open medial meniscectomy (32) and unoperated controls (40). The complete medial meniscectomy was always only performed on the right knee. Thus, a third intraindividual control was available for each animal. At 2, 4, 8 and 12 weeks after surgery, 8 rabbits each were sacrificed. The same number of unoperated control animals was employed at the respective timepoints and 8 rabbits were used as untreated baseline control. Use of all animals had been permitted by the government (Regierungspräsident).
The macroscopic grading was performed on all the right and left knee joints using the scheme of the ICRS which evaluates 9 areas per each medial/lateral tibia/femur and patella. Specific areas and area sums of all joint sites were statistically analysed (Wilcoxon and Mann-Whitney-U test). In addition, the location of (chondro-) osteophytes was recorded. The synovia was graded using the following degrees: Normal, slightly bloody appearance, bloody apperance, yellowish apperance.
For microscopic evaluation, 4 mm sections of the central tibial plateaus were stained with H&E and Safranin O. A histologic grading was performed with a dedicated grading system.
Results: All animals (n = 72) were free of signs of infection and had a "normal" postoperative course. Lesions were almost solely detected on the medial joint site after medial meniscectomy. At 2, 4, 8, and 12 weeks after medial meniscectomy, the overall scores were clearly elevated at the operated right side compared to the unoperated contralateral side ($p < 0.01$). At 2, 4, and 12 weeks, the tibial scores were higher than the femoral scores. Nevertheless, a high overall - correlation was found for the tibial and femoral site ($p < 0.01$). The detailed mapping of the ICRS scheme allows for visualising the lesion locations graphically and systematically. It also allows for following the timecourse of pathology. No time-related differences were observed in unoperated rabbits. (Chondro-) osteophytes were highly correlated with the disease state of the tibial articular cartilage. The used macroscopic synovial grading did not demonstrate any influence on the hyaline cartilage OA status. Histologic scores showed early OA after complete medial meniscectomy, when compared with the unoperated contralateral side and compared with unoperated rabbit knee joints.
Conclusions: The involvement of specific areas of the knee joint cartilage can be well demonstrated using the mapping as proposed by the ICRS. Based on this system, a comparison between studies of different investigators and different strains should be possible. This has not been presented in the literature to date. It also allows following the time course. The ICRS system is therefore suggested for the use in animal studies.